SAMPLING AND ANALYSIS PLAN
CHEMICAL SOIL BACKGROUND STUDY
SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

FINAL REVISED (DRAFT)

APPENDIX B - QUALITY ASSURANCE PROJECT PLAN

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
DEPARTMENT OF TOXIC SUBSTANCES CONTROL

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FINAL REVISED
QUALITY ASSURANCE PROJECT PLAN
CHEMICAL SOIL BACKGROUND STUDY

SIGNATURE AND APPROVAL SHEET

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Douglas I. Sheeks, P.G. 5211
Engineering Geologist / Project Manager
DTSC, Sacramento

_____

John Quinn, Ph.D.
Project Chemist
Environmental Chemistry Laboratory
DTSC, Berkeley

_____

Mark Malinowski, P.G. 6695
Supervising Engineering Geologist / Program Manager
DTSC, Sacramento

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LIST OF ACRONYMS AND ABBREVIATIONS

Boeing	The Boeing Company
bgs	below ground surface
CBRA	Chemical Background Reference Area
CDPH	California Department of Public Health
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
COC	Chain of Custody
CRDL	Contract Required Detection Limit
CrVI	Hexavalent chromium
DoD	Department of Defense
DOE	Department of Energy
DQO	data quality objective
DTSC	Department of Toxic Substances Control
EDL	Estimated Detection Limit
EIS	Environmental Impact Statement
ELAP	Environmental Laboratory Accreditation Program
ICP	Inductively Coupled Plasma
ICPMS	Inductively Coupled Plasma Mass Spectrometry
L	Liter
LCL	Lower Confidence Limit
LCS	Laboratory Control Sample
µg/kg	microgram per kilogram
µg/L	microgram per liter
MEC^X	MEC^X, LP

MDL	Method Reporting Limit
mg/kg	milligram per kilogram
mg/L	milligram per liter
mL	milliliter
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NASA	National Aeronautics and Space Administration
NELAP	National Environmental Laboratory Accreditation Program
NIST	National Institute of Standards and Technology
oz	ounce
PAH	Polynuclear Aromatic Hydrocarbon
PDF	Portable Data File
pg/g	picograms/gram
ppb	parts per billion
ppm	parts per million
ppt	parts per trillion
PT	Proficiency Test
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RL	Reporting Limit
RPD	Relative Percent Difference
SB	Soil Background
SIM	Selective Ion Monitoring
SOP	Standard Operating Procedure
SSFL	Santa Susana Field Laboratory
UCL	Upper Confidence Limit
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1.0 PROJECT MANAGEMENT

1.1 PROJECT/TASK ORGANIZATION

This Quality Assurance Project Plan (QAPP) describes the quality elements that govern the activities to conduct an investigation for chemical background concentrations in soil and sediment to support the environmental investigation and closure activities at the Santa Susana Field Laboratory (SSFL) located in Ventura County, California. The original draft of this QAPP was developed by MEC^X, LP (Aurora, Colorado), under contract to The Boeing Company (Boeing), the National Aeronautics and Space Administration (NASA), and the United States Department of Energy (DOE). In order to address community and stakeholder concerns, DTSC revised the original draft to form this final QAPP. DTSC acknowledges and appreciates Boeing's, NASA's, and DOE's support for and MEC^X's efforts in developing the original draft QAPP. The sampling and analyses will be conducted, respectively, by a contractor and laboratories to be selected under DTSC's guidance and oversight.

This QAPP is appended to the Chemical Soil Background Study Sampling and Analysis Plan (SAP), but is prepared as a stand-alone document for use during implementation of the Chemical Soil Background Study (Study). The final SAP and QAPP are available on DTSC's Santa Susana website: *http://www.dtsc.ca.gov/SiteCleanup/Santa_Susana_Field_Lab/ssfl_document_library.cfm* and will be distributed to DTSC's background Study contractor for field sampling, laboratory and split (QA/QC) laboratory analysis, and data validation and review as well as members of the public and other stakeholders, including Boeing, NASA, and DOE.

1.2 PROBLEM DEFINITION AND BACKGROUND

The Santa Susana Field Laboratory (SSFL) is a 2,850-acre site located in Ventura County, California, approximately 2 miles south of the City of Simi Valley and 30 miles northwest of downtown Los Angeles. The principal activities at SSFL were large rocket engine research, assembly, and testing and nuclear energy research and development. These past site operations have resulted in soil and groundwater contamination.

Currently, there are several ongoing environmental programs at SSFL to comply with regulatory requirements and achieve site closure. Many of these environmental programs may require the use of chemical soil background concentrations, most notably the RCRA Program and the Environmental Impact Statement (EIS) being prepared by DOE for activities in Area IV. The SSFL RCRA Corrective Action Program is currently in the RCRA Facility Investigation (RFI) phase. The purpose of the RFI is to

assess the nature and extent of chemicals in environmental media, gather data to support the next phases of the RCRA Corrective Action Program, and identify areas for further work. The RFI is functionally equivalent to the Remedial Investigation (RI) phase of the California Superfund process. Investigation for the RFI/RI is being conducted at the former operational areas (referred to as "RFI/RI Sites"), including surrounding areas, as needed, and in undeveloped land within and surrounding the SSFL.

This QAPP was prepared to describe sample collection and laboratory analyses of selected chemicals in off-site soils and the reporting of the Study's results for future use during characterization and cleanup decisions at SSFL.

The purpose of the present Study is to establish a regulatory agency-approved, publicly-reviewed, and scientifically-and technically-defensible chemical soil background dataset for SSFL environmental programs. Both California EPA and USEPA regulatory guidance state that a key criterion for a background dataset is site representativeness (DTSC 1997 and 2008; USEPA 2002a and 2002b). More specifically, these guidance documents indicate that background soil samples should have the same basic characteristics as the site samples (i.e., similar soil depths and soil types) and should be representative of the site's physical, chemical, geological, and biological characteristics (UESEPA 2002a). This requires the SSFL background dataset be developed and used in a manner representative of the range of naturally-occurring constituent concentrations that are related to topographic, geological, soil, and biological conditions present at SSFL.

1.3 PROJECT/TASK DESCRIPTION

- Establish a regulatory agency-compliant, publicly-reviewed, and technically-defensible soil background dataset for SSFL environmental programs. These background data will be used for SSFL program site characterization and cleanup purposes.
- Provide a definition of background that identifies the naturally-occurring and anthropogenic compounds, providing agency definitions and guidance references.
- Collect sufficient distinct sample types (surface and subsurface soils; surface ephemeral sediments) from approved, selected locations to enable evaluation of selected analytes and establishment of background soil concentrations for these target analytes for the aforementioned types of samples.
- Obtain data of sufficient quality and quantity to allow:
    - statistical comparison of concentrations of the new background soil dataset,
    - development of criteria for the use of existing data, and
    - determination of any limitations on the background dataset's use.
- Obtain data of sufficient quality and quantity for evaluation and development of a background soil dataset for use in SSFL environmental programs.

1.4 DATA QUALITY OBJECTIVES

In addition to complying with agency guidance, the DQO approach is being used for the Study because it provides a robust framework to ensure that sufficient data of high quality are collected to meet the Study's needs. The DQO process consists of the following seven steps:

1. State the problem
2. Identify the decision questions
3. Identify inputs into the decision questions
4. Define the study boundaries
5. Develop a decision rule
6. Specify limits on decision errors
7. Optimize investigation design

The problem statement for the Study is:

> Soil chemical concentration data from off-site background reference areas are needed to establish a regulatory agency-compliant, publicly-reviewed, and technically-defensible chemical soil background dataset for SSFL environmental programs.

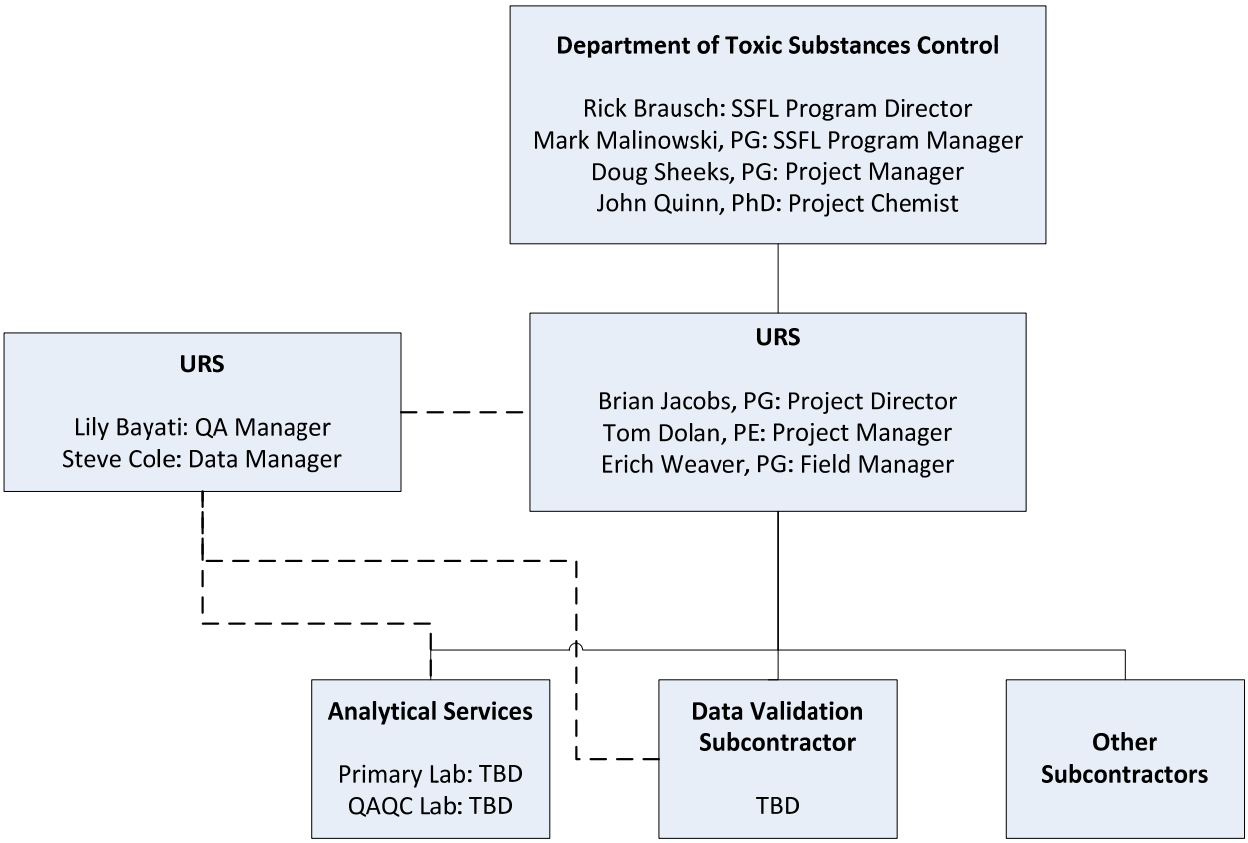
The following decision statement is identified to provide a background dataset that will satisfy the above problem statement:

> Evaluate off-site areas to identify locations representative of SSFL site characteristics, determine an appropriate sampling and analysis design to collect representative background data, and describe procedures to implement the Study's sampling program.

The remaining DQO steps are provided in Table 1.

1.5 PROJECT ORGANIZATION AND COMMUNICATION

This section provides a description of the organizational structure and responsibilities of the individual positions for this project. This description defines the lines of communication and identifies key personnel assigned to various activities for the project. The organizational structure of the project is presented in the following chart:



ORGANIZATION CHART
Santa Susana Field Laboratory
Chemical Soil Background Study
Ventura County, CA

1.5.1 Program and Project Management (DTSC)

Mr. Rick Brausch and Mr. Mark Malinowski are, respectively, DTSC's SSFL Program Director and Program Manager who are responsible for the overall direction and management of the SSFL program and its various projects. Mr. Doug Sheeks is the Project Manager for the background Study and is the DTSC representative responsible for overseeing the Study's work, including reviewing and approving work activities such as data collection, laboratory analysis, data evaluation, and reporting. Dr. John Quinn is the DTSC Project Chemist for the Study who provides assistance to DTSC's Program and Project Managers dealing with the Study's laboratory-related issues, including Quality Assurance and Quality Control (QA/QC) requirements; helps to oversee the efforts by and results from DTSC's contractor (URS), reviews laboratory analytical and data validation results; and makes recommendations as may be needed to address concerns.

1.5.2 SAP Implementation (URS)

The SAP implementation contractor, URS, is responsible for the assigned investigation and reporting phases of the Study. Together, the contractor's management team (Project Director, Project Manager, Field Manager, and Laboratory QA Manager) will be responsible for the technical planning and implementation of the work prescribed in the SAP. The contractor's QA staff is responsible for effective planning, verification and management of QA activities associated with the Study.

Mr. Brian Jacobs is the URS Project Director. Mr. Jacobs will serve as the primary contact for DTSC. Mr. Jacobs has the authority to commit the necessary resources of URS to ensure timely completion of project tasks. His responsibilities include strategy development, budget control, and document review.

Mr. Tom Dolan is the URS Project Manager for the Study. Mr. Dolan is responsible for overall implementation of the SAP. As Project Manager, Mr. Dolan will provide day-to-day management and tracking of the project scope, schedule, and budget. Other responsibilities include coordination and preparation of the required reports and assignment of technical responsibilities to appropriate personnel and/or subcontractors.

Mr. Erich Weaver is the Field Manager and Site Safety Officer for URS. Mr. Weaver is responsible for the day-to-day coordination of field activities under the direction of the URS Project Manager. Other responsibilities include coordination of subcontractors and field crews to ensure that field activities conform to the specifications presented in the SAP and Health and Safety Plan.

Ms. Lily Bayati is the URS QA Manager. Ms. Bayati is responsible for the QA and QC aspects of the Study. It is the responsibility of the QA Manager to ensure that all required QA/QC protocols are met in the field and laboratory. Ms. Bayati will also provide oversight of related data validation activities.

1.5.3 Analytical Services

The process to select the Study's primary and secondary (QA/QC) analytical laboratories is currently underway. The results of that process are presented in this draft updated QAPP that is being released for public review and comment before being finalized. Each laboratory will be a State of California-certified environmental laboratory and will have met DTSC's selection criteria, including audits of laboratory certifications, records, procedures, and facilities. These laboratories will perform the analytical testing of the primary and QA/QC soil samples collected for this Study. The respective Laboratory Directors will assign specific Laboratory Project Managers who will report solely to the URS Project Manager and/or URS QA Manager on any and all aspects of the sample analyses. Additionally, laboratory personnel will report any directives or inquiries from third parties regarding this Study's sample analyses immediately to the URS Project Manager and/or URS QA Manager who, in turn, will immediately report such communication to the DTSC Project Manager. The URS QA Manager will also be advised of any matters related to data quality during the course of the Study. The laboratories will conform to the QA and QC procedures outlined in their respective laboratory QA plan/standard operating procedures and to this QAPP.

1.6 FIELD AND LABORATORY DATA QUALITY CRITERIA

The overall quality objectives and criteria for measurement data are to develop, implement and document procedures for obtaining and evaluating data in an accurate, precise, and complete manner so that analytical data, sampling procedures, and field measurements provide information that is representative of site background conditions.

This document establishes procedures necessary to produce technical products of consistent quality. Field and laboratory activities will be performed by properly trained and qualified personnel and will conform to specific procedures outlined in this QAPP and the Study's SAP to which this QAPP is appended. Project deliverables resulting from these activities will be reviewed using data quality criteria. Data quality criteria indicators (USEPA 2002c) include the following: accuracy, precision, completeness, representativeness, comparability, sensitivity, and integrity. The following discussion of data quality criteria is for definitive-level data, though the same criteria (but not necessarily the same procedures, units, or values) may also be applied to monitoring-level and screening-level analytical data.

Precision – Measures the reproducibility of repetitive measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the sample process under similar conditions.

Analytical precision is a measurement of the variability associated with duplicate or replicate analyses of the same sample in the laboratory and is determined by analysis of laboratory quality control samples, such as duplicate control samples (LCSD or DCS), field-designated matrix spike duplicates (MSD), or sample duplicates. If the recoveries of analytes in the specified control samples are comparable within established laboratory control limits, then precision is within limits.

Total precision is a measurement of the variability associated with the entire sampling and analytical process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate samples are analyzed to assess field and analytical precision.

Duplicate results are assessed using the relative percent difference (RPD) between duplicate measurements. If the RPD for laboratory quality control samples exceeds the laboratory's statistically-determined acceptance ranges, data will be qualified as described in the applicable validation procedure. If the RPD between primary and duplicate field samples exceeds 50 percent (USEPA 2006) for soil samples, data will be qualified as described in the applicable validation procedure. The RPD will be calculated as follows:

$$\%\text{RPD} = 200\% \times (X_2 - X_1) / (X_2 + X_1)$$

where 'X_1'is the smaller of the two observed values and 'X_2'is the larger of the two observed values.

Bias - The systematic or persistent distortion of a measurement process that causes errors in one direction.

Accuracy – The degree of agreement between a measurement and an accepted reference or "true" value, includes a combination of random error (precision) and systematic error (bias) components of both sampling and analytical operations.

Accuracy of measurement data will be assessed and controlled through the use of Proficiency Testing (PT) samples, laboratory control samples (LCSs), laboratory control sample duplicates (LCDs), and site-specific matrix spikes (MSs) and matrix spike duplicates (MSDs). Accuracy is expressed as the percent recovery (%R). Statistically-derived laboratory accuracy limits are included with the respective laboratory QA plans. If the percent recovery is determined to be outside of acceptance criteria, data will

be qualified as described in the applicable validation procedure. The calculation of percent recovery is provided below:

$$\%R = 100\% \times (X_s - X) / T$$

Where 'X_s' is the measured value of the spiked sample, 'X' is the measured value of the unspiked sample, and 'T' is the true value of the spike solution added.

Field accuracy will be assessed through the analysis of field and equipment rinsate blanks (see SAP Section 3.4.7). Analysis of these blanks will monitor errors associated with the sampling process, possible field-related contamination, and sample handling. The DQO for equipment rinsate blanks is that all values are less than the reporting limit for each target constituent. If contamination is reported in the either the field or equipment rinsate blanks, data will be qualified as described in the applicable validation procedure.

The project goal for accuracy is 90-percent compliance with accuracy criteria. If more than 10 percent of the data are qualified due to failure to meet accuracy criteria, the reasons will be examined and addressed. Initiation of corrective action may be required if laboratory accuracy is determined to be the problem.

Representativeness – Refers to a sample or group of samples that reflects the characteristics of the media at the sampling point. The degree to which data accurately and precisely represent a characteristic of a population, parameters variations at a sampling point, a process condition, or an environmental condition. It also includes how well the sampling point represents the actual parameter variations that are under study. This QAPP, together with the SAP, addresses representativeness by specifying sufficient and proper numbers and locations of samples; incorporating appropriate sampling methodologies; specifying proper sample collection techniques and decontamination procedures; selecting appropriate laboratory methods to prepare and analyze soil samples; and establishing proper field and laboratory QA/QC procedures.

Representative data will be obtained by following proper and consistent procedures as well as application of approved laboratory-specific SOPs, including any DTSC-approved modifications to the SOPs. Sampling locations will be selected as described in the Study's SAP. QA/QC limits for the Study are provided in Table 2.

Comparability – Expresses the confidence with which one data set may be compared to another and may be combined for the decision(s) to be made. The objective of comparability is to ensure that data developed during the investigation are comparable to Site knowledge and adequately address applicable

criteria or standards established by the USEPA. This QAPP addresses comparability by specifying laboratory methods that are consistent with the current standards of practice as approved by the USEPA. Field methods are discussed in the SAP.

Data comparability will be achieved by using standard units of measure (e.g., milligram per kilogram [mg/kg] for inorganics and micrograms per kilogram [µg/kg] for organics in soil samples). Dioxins and furans analyzed by EPA Method 1613 will be reported in picograms per gram (pg/g) or nanograms per kilogram (ng/kg), which are equivalent in soil samples. For solids, all results will be reported on a dry-weight basis.

Completeness – The amount of valid data obtained from a measurement system compared to the amount that is expected and necessary to meet the project data goals. The completeness goal for all data uses is that a sufficient amount of valid data be generated so that determinations may be made related to the intended data use with a high degree of confidence. The evaluation of the data completeness will be performed at the conclusion of the sampling and analysis effort, including receipt of validated data. Corrective actions, such as revised sample handling procedures, may be implemented if problems are noted.

The completeness of the data generated will be determined by comparing the amount of valid data, based on independent validation, with the total data set. The number of valid results divided by the number of possible results, expressed as a percentage, determines the completeness of the data set. The objective for completeness is to recover at least 90% or greater (EPA 2000; 2004) for data generated during the soil background investigation. The formula for calculating completeness is as follows:

$$\% \text{ Completeness} = 100\% \times \textit{number of valid results / number of expected results}$$

Sensitivity – Sensitivity is the ability of an analytical method or instrument to discriminate between measurement responses representing different concentrations. This capability is established during the planning phase to meet project-specific objectives. It is important to be able to detect the target analytes at the levels of interest. Sensitivity requirements include the establishment of various limits, which are described below in Section 4.3, such as calibration requirements, and project-specific method detection limits (MDLs) and reporting limit (RLs). Both the MDLs and RLs are normally based on an interference-free matrix (i.e., purified solid), which do not take into account matrix effects and may not be achievable for environmental samples.

The analytical reporting limits will be determined based on the completion of instrument-specific MDL studies performed in accordance with the methods prescribed by 40 Code of Federal Regulation (CFR)

Part 136, Appendix B (USEPA 1984). The validity of the MDLs shall be verified by the detection of the analyte in a QC sample in each matrix. The RL will be established by the laboratory, generally by multiplying the statistically-calculated MDL by a factor ranging from 3 to 5 as recommended by generally-accepted laboratory practices and is further supported by the lowest-level analytical standard in the initial calibration process. All laboratories will report estimated detected results, "J" values, between the RL and the MDL for all methods unless specified otherwise.

1.7 SPECIAL TRAINING/CERTIFICATIONS

The planned fieldwork will be conducted in generally natural, undeveloped areas with no known use of hazardous materials. Field sampling will be conducted in accordance with a site-specific health and safety plan (HASP) approved by a Certified Industrial Hygienist (CIH) that takes into account potential physical and biologic hazards that could be encountered by field personnel. Each subcontractor will be responsible for the compliance of their personnel with the applicable health and safety training requirements as specified in the HASP.

The laboratories performing the Study's sample analyses will be accredited by the State of California Department of Public Health (CDPH) under the National Environmental Laboratory Accreditation Program (NELAP). The laboratories must be approved for each parameter of analysis under NELAP. If there is no California accreditation of an analytical parameter, accreditation through another NELAP accreditation body or by a Department of Defense (DoD) quality assurance program will be considered with approval from the Study's Project Chemist. Additional consideration will be given to emerging technology utilized to meet a specific site characterization need.

1.8 DOCUMENTATION AND RECORDS

Field sampling documentation requirements are specified in Standard Operating Procedures (SOPs) provided in Appendix C of the Study's SAP. Daily activities and site conditions will be recorded in a weatherproof, bound field notebook or field log sheets maintained by the field geologist(s). Soil boring logs will be completed for each sampling station. Health and safety records, including visiting personnel, will be maintained in the field by the on-site safety officer. The lead project geologist will review all field notes and logs for completeness and accuracy during the field activities.

Sampling stations also will be photo-documented during staking and sampling, such that a photographic record will be maintained for each field event performed for this project. GPS survey coordinates will be recorded in the field electronically during both staking and sampling to ensure reproducibility.

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2.0 DATA GENERATION AND ACQUISITION

2.1 SAMPLING PROCESS DESIGN

Soil sampling will be conducted by a qualified contractor selected by DTSC. DTSC will provide field supervision and oversight to ensure that the sampling is done according to the Study's final DTSC-approved SAP. All fieldwork shall be supervised by a California Professional Geologist (PG) or Professional Engineer (PE) provided by the contractor. The following sections describe sampling procedures, equipment decontamination, documentation and record keeping, and additional property-access requirements.

2.1.1 Chemical Analysis

As discussed more generally in the SAP (Section 2.0), the chemical analyses for the Study include both naturally-occurring and potential regional anthropogenic chemicals; the latter being present in the broader environment due to natural processes (e.g., atmospheric fallout). Based on further consideration of a request from the Responsible Parties (Boeing 2011), DTSC agreed (DTSC 2011) to include alcohols (i.e., ethanol and methanol), cyanide, formaldehyde, and nitrate in the Study. Supporting this decision are documented occurrences in the environment (Agency for Toxics Substances and Disease Registry 1999; Argonne National Laboratory 2005; Barber et al 2002; Malcolm Pirnie 1999; Ulrich 1999) due to natural processes of formation coupled with detections in soil samples collected at SSFL under the RFI program and the current "co-located" sampling project being conducted at SSFL Area IV.

These additional chemicals will be tested for in both surface and subsurface soil samples, with the exception of the alcohols that will be tested for only in the subsurface soil samples. Thus, each of the 240 total primary soil samples will be analyzed for inorganic constituents plus cyanide, formaldehyde, and nitrate. The 60 subsurface samples will be analyzed for the alcohols. And, each of the 120 surface samples will be analyzed for the other organic constituents listed in SAP Section 2.0.

Testing for the alcohols in the subsurface is in accordance with DTSC's expectation that, due to these chemicals being volatile compounds, that they are not likely to be found in surface soils. However, although having agreed to test for these additional chemicals, DTSC does not expect that they will be found in either significant numbers of background samples or, if detected, at significant concentrations.

2.2 SAMPLING METHODS

Field sampling and logging procedures are described in SOPs provided in Appendix C to the Study's SAP. The following is a brief description of the work to be performed.

2.2.1 Surface Soil Sampling

At each sampling station, a minimal area of surficial vegetation, just sufficient for sampling, will be carefully removed by scraping the surface with a pre-cleaned trowel. Surface soil samples will be collected using either laboratory-supplied containers or by driving 6-inch-long by 2-inch-diameter stainless steel sleeves into the upper 6 inches of soil using a slide hammer. Hexavalent chromium (CrVI) analysis requires soil samples to be shipped in a plastic container, so an additional sleeve will be advanced about three inches into the auger hole and its contents emptied into a laboratory-supplied plastic container. The depth assigned to samples in the database will be the bottom of the sample interval (e.g., 0.5 feet bgs). The actual collection depth of the CrVI sample should be noted on the soil boring log, but for sample management and recording information for the project, the CrVI sample depth should be the same interval as the primary sample to avoid confusion of multiple sampling depths for different analytes.

2.2.2 Subsurface Soil Sampling

Subsurface soil samples (from non-drainage areas) will be collected from the same auger hole as the surface sample and the auger hole will be advanced to the target sample depths using a decontaminated hand auger. These samples will be collected in the same manner as surface samples. The target depths will be between 2-feet and 10-feet bgs, unless bedrock refusal is met. If bedrock refusal is met before 3.5-feet bgs, then no subsurface sample will be collected at that sampling station and an alternative sample location will be selected based on the procedure described in Appendix A to the SAP; a depth of 3.5 feet bgs was selected because it would provide 18 inches of soil sample volume (within 2-inch-diameter stainless steel sleeves), which is approximately the minimum soil volume required to conduct the laboratory chemical analyses and grain size analysis.

Handling and Custody - Chain-of-custody (COC) procedures will be followed to track the samples. The COC form will document the transfer of samples from the field to the laboratory. The COC will summarize the contents of the shipment and track the dates and times of any custody transfer with signatures of all parties relinquishing and receiving the samples.

From the time the sample is collected, it will be under the control of sampling personnel, including DTSC. Upon collection, the samples will be temporarily stored in insulated backpacks or suitable containers (cooled with ice or dry ice) and transferred to coolers within 4 hours. Before sampling

personnel relinquish the samples to the designated courier or laboratory representative, the samples will be inspected and their condition documented. Water ice will be placed in sealed "Ziplock" bags and placed around the samples within the coolers to maintain the required 4 +/- 2° C temperature within the coolers. DTSC personnel will affix custody seals on the coolers. Samples will then be relinquished to the designated courier or laboratory representative. A copy of the COC will be maintained by the field contractor for DTSC. If the samples cannot be shipped or relinquished to the laboratory on the day they were collected, the samples shall be maintained on ice in a secure location for shipment the following day. DTSC staff shall re-inspect the coolers adding ice and draining melted ice/water and resealing the coolers prior to relinquishment.

Upon receiving the samples, the laboratories will accept custody of the shipped samples and verify that the information on the sample containers match the COC records. The laboratory sample custodian will notify the contractor Project Manager of sample receipt and confirm the work order prior to the initiation of analyses. The laboratories will use the sample identification number and assign a unique laboratory number to each sample and ensure that all samples are transferred to the proper analyst or stored in an appropriate and secure area.

The laboratories will return completed copies of the COC forms with the analytical results. The completed forms will indicate custody of the samples by date and signature and the work order for each sample. Preservation, container, sample mass or volume, and holding-time criteria for soil background samples to be collected are listed in Table 3.

2.2.3 Sample Naming Convention

The Study's soil sample naming convention will follow the SSFL RFI sample naming convention which was developed to allow a consistent approach for a complex investigation with multiple investigation areas and numerous laboratories.

The Sample Identifier, called the "Sample ID," is generally a twelve-character designator for sample identification with three optional characters for special samples. These identifiers are tied to a specific RFI site, a unique sample location, sampling depth, and sample media. The Sample IDs are the sample names shown on RFI site maps. Each Sample ID has the following format:

aabbccccdeeefff (e.g., WRSB0001S020, CZSB0002S035)

where:

aa Site Identification. Two-letter site identification code (WR [Wood Ranch] or CZ [China Flat]. These site IDs are specified for each CBRA Site.

bb Sample Matrix Type. Each sample matrix type was assigned one or several two-letter codes. For example, soil boring samples as "BS", etc. The sample matrix-specific two-letter code BS is used to identify a soil matrix, boring, surface, or sediment sample.

cccc Sample Location. The sampling location number is a four-number code that relates to the location (or coordinates) of the sample (0001, 0002, etc.).

d Sample Type. Primary samples are designated "S," duplicate samples "D," trip blanks "T," other QC samples "Q".

eee Sample Depth. The depth of the sample in feet below ground surface (bgs), using one decimal place. For example, 005 is 0.5 feet bgs, and 055 is 5.5 feet bgs.

fff: Optional character. This optional character is appended to the sample ID to identify split samples (SP); or other special samples.

Field Blanks and Equipment Blanks (Equipment Rinsates) are named in the following manner:

Field Blank: FBQW0000 where 0000 is an incremental sequential number. Equipment Blank: EBQW0000 where 0000 is an incremental sequential number.

2.3 ANALYTICAL METHODS

Soil background samples will be collected and submitted for off-site laboratory analysis. The methods for which the soil background samples may be analyzed are listed in Table 4. As discussed below, Table 4 will be updated to include the required minimum RLs for each target analyte as reported by the selected primary laboratory(ies). The selected laboratories will be instructed to consider the moisture content of the samples collected and compensate (increase sample volume) for the moisture content in excess of the typical amounts (10%) when conducting the preparation of the samples for analysis. The laboratories are not to dry the samples prior to analysis to avoid loss of constituents of concern. All soil data are to be reported on a dry-weight basis (which would raise the laboratory RLs and method detection limits [MDLs] by a commensurate amount; 10%).

2.4 FIELD QUALITY CONTROL

The following QC procedures are established for field sampling to ensure that all soil background samples are collected in a manner consistent with QA objectives. All QC samples will be submitted to the analytical laboratories and analyzed in a manner consistent with the primary samples. Duplicate and laboratory confirmation (split) samples will be collected to assess variability in the sample media and sampling and analytical precision. Duplicate and split samples will be collected in the same manner and at the same depth as the primary samples; however, the duplicate and split samples will be collected immediately adjacent to the primary sample (within approximately a 1-foot radius).

Matrix spike/matrix spike duplicate samples will be used as a tool in determining precision and accuracy. Field blanks and equipment rinsates will be evaluated to determine site conditions verses contaminates introduced from the sampling and/or analytical process.

- Sample duplicates, or collocated samples, will be collected at the rate of 10% of the primary background samples.
- Split samples will be collected at the rate of 10% of the primary background samples. Split samples will be submitted to a separate laboratory for inter-laboratory comparison.
- Matrix spike/matrix spike duplicate pair samples will be collected at the rate of 10% of the primary background samples, or as may be specified by the laboratory.
- Field blanks (deionized water) will be collected from each supply of deionized water used for decontamination, or more frequently if warranted.
- Equipment rinsates will be collected each day per type of sampling equipment being utilized on site for which site samples are being collected for laboratory analysis.
- Trip blanks supplied by the laboratory will be analyzed for the Study's sole volatile organic compound analyte group (i.e., alcohols) for each day when one or more collected soil samples are designated for the alcohol analysis.

The listed frequencies are the minimum and may be increased if field conditions or preliminary analytical results indicate the need for more frequent collection. The effectiveness of control actions are determined and documented by the following: QA reports are issued, control samples are reported and validated, control samples are used in the validation of other site samples, and an overall evaluation of the data is performed to include control actions and control samples.

2.5 LABORATORY QUALITY CONTROL ELEMENTS

Laboratory QC samples (e.g., blanks and laboratory control samples) shall be included in the preparation batch with the field samples. An analytical batch is a number of samples (not to exceed 20 environmental samples plus the associated laboratory QC samples) that are similar in composition (matrix) and that are extracted or digested at the same time and with the same lot of reagents.

Matrix spikes and matrix spike duplicates count as environmental samples. This laboratory analytical batch is a number of samples (not to exceed 20 environmental samples plus the associated laboratory QC samples) that are similar in composition (matrix) and analyzed sequentially.

The identity of each analytical batch shall be unambiguously reported with the analyses so that a reviewer may identify the QC samples and the associated environmental samples. All references to the analytical batch in the following sections in this QAPP refer to the laboratory analytical batch.

By performing the appropriate laboratory quality control, analytical batch control is established and may be monitored by the laboratory and the data validation contractor. Field QC samples may then be submitted to represent each unique media and cover the duration of the sampling program while maintaining a cost-effective QA/QC strategy.

2.5.1 Method Detection Limits

The MDL is the minimum concentration of a substance in a sample that does not cause matrix interferences, that may be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The laboratories shall establish MDLs for each method, matrix, and analyte for each instrument the laboratories plans to use for the project. The laboratories shall revalidate these MDLs at least once per 12-month period. The laboratories shall provide the MDL demonstrations at the beginning of the project (i.e., before project samples are analyzed).

2.5.2 Reporting Limits

The RL is the lowest concentration at which an analyte can be detected in a sample and its concentration can be reported with a reasonable degree of accuracy and precision. For samples that do not pose a particular matrix problem, the RL is typically about 3 to 5 times higher than the MDL. The laboratories participating in this work effort shall compare the results of the MDL demonstrations to the RLs for each method (Table 4) established for the background Study. The laboratories shall also verify the RLs by including a standard at or below the RL as the lowest point on the calibration curve. All results shall be reported at or above the MDL values. However, for those results falling between the MDL and the RL, a "J" flag shall be applied to the results indicating the variability associated with the result.

2.5.3 Method Detection and Reporting Limits

The target RLs for this Study will be driven by project-specific Rural Residential Risk-Based Screening Levels (RR-RBSLs) to be established by DTSC. Project-specific MDL and RL studies are being conducted to establish the lowest practical and achievable RLs (and MDLs) based on standard USEPA analytical methods with DTSC-approved procedure modifications when required. For the majority of the analytes, the target RLs are expected to be less than the corresponding RBSLs. When the Study's laboratories are selected and the audits completed, this QAPP will be updated to include listings of the RR-RBSLs, MDLs, and RLs and other related, relevant information.

2.5.4 Instrument Calibration

Analytical instruments shall be calibrated in accordance with the analytical methods. All analytes reported shall be present in the initial and continuing calibrations and these calibrations shall meet the acceptance criteria specified in the method. All results reported shall be within the calibration range. Results outside the calibration range are unsuitable for quantitative work and will only give an estimate of the true concentration. Records of standard preparation and instrument calibration shall be maintained. Records shall unambiguously trace the preparation of standards and their use in calibration and quantitation of sample results. Calibration standards shall be traceable to standard materials.

Instrument calibration shall be checked using all of the analytes listed in the QC acceptance criteria (Table 2). All calibration criteria shall satisfy method-specified requirements at a minimum. The initial calibration shall be checked at the frequency specified in the method using materials prepared independently of the calibration standards. Multipoint calibrations shall contain the minimum number of calibration points specified in the method with all points used for the calibration being contiguous. If more than the minimum number of standards is analyzed for the initial calibration, all of the standards analyzed shall be included in the initial calibration. The only exception to this rule is a standard that has been statistically determined as being an outlier that can be dropped from the calibration, providing the requirement for the minimum number of standards is met. Acceptance criteria for the calibration check must meet the method-established requirements. Analyte concentrations are determined with either calibration curves or response factors (RFs). For gas chromatography (GC) and gas chromatography/mass spectroscopy (GC/MS) methods, when using RFs to determine analyte concentrations, the average RF from the initial five-point calibration shall be used. The continuing calibration shall not be used to update the RFs from the initial five-point calibration. The continuing calibration verification cannot be used as the laboratory control sample (LCS). In addition, the concentration used for the calibration verification sample shall be at or below the middle of the calibration curve. Finally, the lowest standard used must be at or below the RL for each analyte in the method.

2.5.5 Method Blank

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank shall be carried through the complete sample preparation and analytical procedure.

The method blank is used to document contamination resulting from the analytical process and shall be included in every analytical batch.

The presence of analytes in a method blank at concentrations equal to or greater than ½ the RL indicates a need for corrective action (Department of Defense 2010). Corrective action shall be performed to eliminate the source of contamination prior to proceeding with analysis. After the source of contamination has been eliminated, all samples containing the analyte(s) found in the method blank above the RL shall be re-prepared and re-analyzed. No analytical data shall be corrected for the presence of analytes in blanks. When an analyte is detected in the method blank and in the associated samples and corrective actions are not performed or are ineffective, the appropriate validation flag shall be applied to the sample results.

2.5.6 Laboratory Control Sample

The laboratory control sample (LCS) is analyte-free water for aqueous analyses or a choice of Ottawa sand, sodium sulfate, or glass beads 1 mm or smaller in diameter for soil spiked with all analytes listed in the QC acceptance criteria in Table 2 for the method. Each analyte in the LCS shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte (the midpoint is defined as the median point in the curve, not the middle of the range). The LCS shall be carried through the complete sample preparation and analytical procedure.

The LCS is used to evaluate each analytical batch and to determine if the method is in control. The LCS cannot be used as the continuing calibration verification.

One LCS/LCS Duplicate pair shall be included in every analytical batch. If more than one LCS is analyzed in an analytical batch, results from all LCSs analyzed shall be reported. A QC failure of an analyte in any of the LCSs shall require appropriate corrective action, including qualification of the failed analyte in all of the samples as required.

The performance of the LCS is evaluated against the QC acceptance limits given in Table 2. Whenever an analyte in an LCS is outside the acceptance limit, corrective action shall be performed. After the system problems have been resolved and system control has been re-established, all samples in the analytical batch shall be reanalyzed for the out-of-control analyte(s). When an analyte in an LCS exceeds the upper or lower control limit and no corrective action is performed or the corrective action was ineffective, the appropriate validation flag shall be applied to all affected results.

2.5.7 Matrix Spike/Matrix Spike Duplicate

A matrix spike (MS) and matrix spike duplicate (MSD) is an aliquot of sample spiked with known concentrations of all analytes listed in the QC acceptance criteria (Table 2) for the respective method.

The spiking occurs prior to sample preparation and analysis. Each analyte in the MS and MSD shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte. An MS/MSD pair shall be included in every analytical batch. However, for the purposes of this Study, only the Study's samples shall be evaluated with respect to QA acceptance criteria as listed in Table 2. The MS/MSD shall be designated on the chain of custody.

The MS/MSD is used to document the bias of a method due to sample matrix. Thus, for soil samples, laboratories may use the same container for the parent sample, the MS sample, and the MSD sample, if there is enough sample volume. The selected contractor should select the samples for the MS/MSDs. The sample replicates will be generated in the field, to be used by the laboratories to prepare the appropriate MS/MSDs. They are used to document potential matrix effects associated with a site. The MS/MSD results and flags must be associated with or related to samples that are collected from the same site from which the MS/MSD set was collected.

2.5.8 Surrogates

Surrogates are organic compounds that are similar to the target analyte(s) in chemical composition and behavior in the analytical process, but that are not normally found in environmental samples.

Surrogates are used to evaluate accuracy, method performance, and extraction efficiency and shall be added to environmental samples, controls, and blanks, in accordance with the method requirements.

Whenever a surrogate recovery is outside the acceptance limit, corrective action must be performed. After the system problems have been resolved and system control has been re-established, the sample shall be re-prepared and re-analyzed. If corrective actions are not performed or are ineffective, the appropriate validation flag shall be applied to the sample results.

2.5.9 Internal Standards

Internal standards (ISs) are measured amounts of certain compounds added after preparation or extraction of a sample. They are used in an IS calibration method to correct sample results affected by column injection losses, purging losses, or viscosity effects.

ISs shall be added to environmental samples, controls, and blanks in accordance with the method requirements.

When the IS results are outside of the acceptance limits, corrective actions shall be performed. After the system problems have been resolved and system control has been re-established, all samples analyzed

while the system was malfunctioning shall be reanalyzed. If corrective actions are not performed or are ineffective, the appropriate validation flag shall be applied to the sample results.

2.5.10 Retention-Time Windows

Retention-time windows are used in GC analysis for qualitative identification of analytes. They are calculated from replicate analyses of a standard on multiple days. The procedure and calculation method are given in SW-846 Method 8000B.

When the retention time is outside of the acceptance limits, corrective action shall be performed. After the system problems have been resolved and system control has been re-established, all samples analyzed since the last acceptable retention time check shall be re-analyzed. If corrective actions are not performed, the appropriate validation flag shall be applied to the sample results.

2.5.11 Interference Check Sample

The interference check sample (ICS), used in inductively-coupled plasma (ICP) and ICP/MS analyses only, contains both interfering and analyte elements of known concentrations.

The ICS is used to verify background and inter-element correction factors and is run at the beginning and end of each run sequence.

When the interference check sample results are outside of the acceptance limits stated in the method, corrective action shall be performed. After the system problems have been resolved and system control has been re-established, the ICS shall be re-analyzed. If the ICS result is acceptable, all affected samples shall be re-analyzed. If corrective action is not performed or the corrective action was ineffective, the appropriate validation flag shall be applied to all affected results.

2.5.12 Post-Digestion Spike

The post-digestion spike used in ICP and ICP/MS analyses contains all of the compounds of interest in the analytical method as listed in Table 4. The post-digestion spike is used to evaluate matrix effects on the recovery of spiked chemical compounds in the site samples.

When the post-digestion spike sample results are outside of the acceptance limits stated in the method, corrective action may need to be performed or the post-digestion spike repeated to establish matrix interference. If corrective action is not performed or the corrective action was ineffective, or matrix interference is established, the appropriate validation flag shall be applied to all affected results.

2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

All instruments and equipment will receive routine preventative maintenance. At a minimum, all instruments (including backup) will be inspected for usable condition and calibration status prior to each field and laboratory use.

2.7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

All equipment used during monitoring activities will be maintained, calibrated, and operated by field personnel according to manufacturer guidelines and recommendations. Calibration records that are traceable to the equipment will be maintained by field personnel.

Laboratory calibration procedures will be conducted in accordance with the approved quality assurance QA/QC guidelines and laboratory policies. Calibration and maintenance will be performed in accordance with approved calibration and maintenance checks.

If an instrument, either field or laboratory, is found, upon calibration, to be out of calibration criteria, the instrument will be subject to immediate corrective action in accordance with Section 3.

2.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Prior to acceptance, all supplies and consumables will be inspected by the contractor's assigned personnel to ensure that they are in satisfactory condition, are free of defects, and are free of potential sources of contamination with chemical compounds of interest. If defects are noted, the item will be replaced. The Field Team Leader or designated environmental personnel will inspect all supplies and consumables provided by subcontractors, including laboratories.

2.9 NON-DIRECT MEASUREMENTS

Non-direct measurements include information from logbooks, site documents, photographs, topographic maps, and data from other sources that may be used to augment the dataset collected under this project and to assist in decision-making. All logbooks, data sheets, photographs, and topographic maps generated or utilized by the environmental contractor will be documented as specified in this QAPP and the field SOPs (SAP Appendix C) and maintained in accordance with the requirements in Section 2.10. Information from external sources will be evaluated for any limitation on the data use and will be incorporated into project documents with concurrence of the project team, including DTSC. These

sources will be identified in any project reporting documents and these documents will include relevant information on any such sources, including the original generator, associated QC, and limitations on use.

2.10 REPORTING AND DATA MANAGEMENT

A database has been developed to manage the data collected at SSFL. The database will be used to integrate all field and analytical data to allow the access and evaluation of analytical and field data by the project team. Quality assurance and quality control will be maintained through the use of laboratory electronic data deliverables (EDDs), reducing the need to manually enter data and the potential for transcription errors.

Access to the database is restricted to the project team using password protection and will be updated by the database administrator with new analytical data.

All field and laboratory data and documents generated during the Study will be maintained, in a secured facility according to DTSC's records-retention policy, including both paper and electronic copies. Final copies of this documentation, including EDDs, will also be provided to an authorized SSFL representative at the completion of the program. Non-direct measurement documents are specified in Section 2.9 and in the field SOPs (SAP Appendix C). Laboratory data deliverables shall include the following:

All Analyses

All sample receiving information, including the executed COCs, air bills, sample receipt checklists, sample delivery group (SDG) assignment sheets, and any other correspondence relevant to the SDG, will be provided.

Organic Analyses

- Case Narrative (inclusive of each analytical method)
- Sample Results (one complete sample result form for each analysis, reanalysis, or dilution analysis)
- Surrogate Recoveries
- MS/MSD Recoveries
- LCS/LCSD Recoveries
- Method Blank Results
- Tuning and Mass Calibration (as applicable)
- Initial Calibration Summary

- Continuing Calibration Summary
- Sample Run Logs
- Internal Standard Summary (as applicable)
- Inter-column Comparison for GC
- Field Quality Control Sample Results

In addition to the summary information, all supporting raw data (chromatograms, quantitation sheets, and spectra) for all samples, standards, tunes, QC samples, percent solid calculations, bench sheets, and run logs must be included in the data package.

Inorganic Analyses

- Case Narrative (inclusive of each analytical method)
- Sample Results (one complete sample result form for each analysis, reanalysis, or dilution analysis)
- Part 1 Initial and Continuing Calibration Verification
- Part 2 Contract Required Detection Limit (CRDL) Standard
- Blank Results
- Inductively Coupled Plasma (ICP) Interference Check Sample
- ICP Mass Spectrometry (ICPMS) Tune (as applicable)
- Internal Standards Recoveries (as applicable)
- MS/MSD Recoveries
- Post Digestion Spike Sample Recovery (as applicable)
- Laboratory Duplicate Results
- LCS/LCSD Recoveries
- Standard Addition Results (if performed)
- ICP Serial Dilutions
- ICP Inter-element Correction Factors
- ICP Linear Range
- Field Quality Control Sample Results
- Preparation Logs
- Analysis Run Logs

In addition to the summary information, all supporting raw data for all samples, standards, QC samples, percent solid calculations, distillation logs, digestion logs, bench sheets, and run logs will be included in the data package. All sample receiving information, including the executed COCs, air bills, sample

receipt checklist, SDG assignment sheet, and any other correspondence relevant to the SDG, will be provided.

Data will be provided by the laboratory in hardcopy and electronic format on CD in a portable data format (PDF). The hardcopy and PDF will contain all information necessary to reproduce the analytical results reported for each chemical compound for each sample.

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3.0 ASSESSMENT AND OVERSIGHT

Quality assurance oversight will be performed to ensure that the established QC procedures are followed. Activities to be conducted as part of the QA objectives include field and laboratory audits. The audits will be conducted to ensure that the data being collected are reliable and of sufficient quality to ensure that identifying deficiencies and assessing that corrective action is implemented when necessary and to ensure that reporting project status to project management is performed on a regular basis. Audit programs are established and directed by DTSC and contractor QA staff to ensure that field and laboratory activities are performed in compliance with the Study's controlling documents. This section describes responsibilities, requirements, and methods for scheduling, conducting and documenting audits of field and laboratory activities.

3.1 ASSESSMENT AND RESPONSE ACTIONS

3.1.1 Field Audits

Field activities will be monitored by the DTSC and contractor Project Managers to evaluate the implementation of the project QA program to produce reliable sampling and field measurement data.

Field audits will be conducted by the contractor and/or DTSC Project Manager to evaluate the execution of sample collection, sample identification, sample control, chain-of-custody, field documentation, instrument calibration, field measurement, and data acquisition procedures. System audits will evaluate data reduction and management activities, project record completeness, and conformance to procedures for the issuance of all work products. Audit reports prepared by the contractor will be issued to the DTSC Project Manager.

3.1.2 Laboratory Audits

The laboratory and/or Study's Project Managers (or designees) may perform internal-project-system audits if inconsistencies or performance issues are noted during routine analytical data report assessment and inspection.

As a minimum, as part of the laboratory pre-selection process for the Study, the following will be conducted:

Laboratory Audits - Laboratory audits will include reviewing sample handling procedures, internal sample tracking, analytical methods SOPs, analytical data documentation, QA/QC protocols, data reporting, and on-site audits of the laboratories.

Proficiency Test (PT) Samples - Double-blind (concentrations in the samples are known only to the vendor who supplies them) soil PT samples of certified concentrations (3 to 5 times greater than RLs) will be used to assess the accuracy of analytical measurements for definitive-level data. PT sample results will be compared to the certified concentrations and the calculated percent differences. Ninety-five percent of the PT sample results for each method are expected to meet the project goals for accuracy.

Data Audits - Data audits will be performed on analytical results received from the laboratories if issues arise that question the data. These audits will be accomplished through the process of data validation and involve a more detailed review of laboratory analytical records. Data audits require the laboratory to submit complete raw data files to DTSC and contractor for validation and verification. Contractor chemists will perform a review of the data consistent with the level of effort described in the *National Functional Guidelines* (USEPA 2005, 2008, 2010). This level of validation consists of a detailed review of sample data, including verification of data calculations for calibration and quality control samples to assess if these data are consistent with method requirements. The laboratories will make available all supporting documentation in a timely fashion.

Audit Schedule - Audits will be scheduled such that field and laboratory activities are adequately monitored or in the event that discrepancies are identified. The overall frequency of audits conducted for these activities will be based on the importance and duration of the work, as well as significant changes in project scope or personnel.

3.1.3 Corrective Actions

The need for corrective action may be identified during review of data reports, during field and system audits, or during monitoring of QA activities. Identification, correction, verification, and documentation of corrective actions are controlled by this QAPP.

If field and/or sample conditions are encountered that were not anticipated during project planning and the development of field procedures, the DTSC's Project Manager will be immediately consulted concerning the appropriate direction of work. Any deviation from approved procedures will be documented, including field records.

Laboratory non-conformance may be noted during routine analytical data assessment and inspection. In such instances, the laboratory QA manager and appropriate technical specialist will discuss the situation, corrective action will be implemented, and both the contractor's and DTSC's Project Manager will be informed accordingly. If necessary, an audit of the laboratory will be performed to confirm that appropriate corrective actions have been implemented.

3.2 REPORTS BY MANAGEMENT

When audits are conducted, QA reports will be prepared by the assigned personnel that identify the audits, their findings, and finding resolution status. In addition, QA reports will summarize results of QA activities including assessments of measurement data accuracy, precision, and completeness, and any corrective action items. QA reports will be provided to the contractor's and DTSC's Project Manager, maintained within the respective project files, and will be available upon request.

4.0 DATA VALIDATION AND USABILITY

4.1 DATA REVIEW, VERIFICATION, AND VALIDATION

These procedures specify the documentation needed and the technical criteria for data reduction, validation, and reporting. The laboratories are required to submit results that are supported by sufficient backup data and QA/QC sample analysis results to enable reviewers to determine the validity of the data.

4.2 VERIFICATION AND VALIDATION METHODS

4.2.1 Field Measurement Data

If field measurements are collected, field personnel will perform validation of data obtained from field measurements by checking calibration procedures utilized in the field. Variations in data that cannot be explained by local conditions may be assigned a lower level of validity and will be used for limited purposes.

Validation of data will be accomplished by checking calibration records generated in the field and by checking sampling forms and field records for completeness. A summary of data obtained from field measurements and any use limitations will be noted on data sheets or in log entries.

4.2.2 Laboratory Data

Chemical data will be validated according to accuracy, precision, and completeness established in this QAPP. Following internal verification, the data validation will be performed in accordance with guidelines prescribed by the "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review" (2008), "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review" (2010) and "USEPA Contract Laboratory Program for Chlorinated Dioxin/Furan Data Review" (2005).

The soil background sample data will be validated at Level IV (equivalent to validation at Stage 4 per USEPA 2009) as the data are critical and are to be used as part of the basis for cleanup decisions and final remedies at SSFL. The following items are reviewed during the Level IV validation process: sample management (collection techniques, sample containers, preservation, handling, transport, chain-of-custody, holding times); initial and continuing calibration; method blank sample results; continuing calibration blank results; blank spike and LCS results; laboratory duplicate precision, if applicable; surrogate recoveries, if applicable; matrix spike/matrix duplicate (MS/MSD) accuracy and precision; serial dilution precision, if applicable; field QA/QC sample results; gas chromatography/mass

spectroscopy (GC/MS) instrument performance; internal standard performance, target compound identification, compound quantification, reported detection limits; and a definitive review of the raw data.

4.3 RECONCILIATION WITH USER REQUIREMENTS

Data quality assessment reports will be prepared at the contractor and/or DTSC Program Manager's direction to summarize the overall usability of the soil background data. The data quality assessment report will summarize assessments of measurement data accuracy, precision, completeness, and sensitivity, and any corrective action items.

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TABLES

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Table 2 - Quality Assurance/Quality Control Limits
Table 3 - Sample Container, Preservation, and Holding Times
Table 4 - Analytical Methods and Reporting Limits

TABLE 1
DATA QUALITY OBJECTIVES
CHEMICAL SOIL BACKGROUND SAMPLING AND ANALYSIS PLAN
SANTA SUSANA FIELD LABORATORY (Page 1 of 4)

1. Problem Statement	• Soil chemical concentration data from off-site background reference areas are needed to establish a regulatory-compliant, publicly-reviewed, and technically-defensible chemical soil background dataset for the Santa Susana Field Laboratory (SSFL) environmental programs
2. Decision Statement	• Evaluate off-site areas to identify locations representative of SSFL site conditions, determine an appropriate sampling and analysis design to collect representative data, and describe procedures to implement the chemical soil background sampling program.
3. Inputs to the Decision	• *Use of the chemical soil background data:* Background soil data will be used for SSFL characterization sampling and cleanup decisions. As such, a high level of confidence is desired for the dataset. Therefore, the Krishnamoorthy and Mathews (2009) non-parametric method is used to determine the sample size to achieve a 95/95 upper tolerance limit (UTL), which is 59 samples. It is expected that background data may be compared to on-site data using combinations of strata as well as using individual stratum. Therefore, 59 samples per stratum will be collected (rounded to 60 samples to achieve equal shallow and deep sample counts). • *Soil characteristic groups represented at SSFL (termed 'strata'[1])*: Based on geology and geomorphic terrain at the SSFL, four strata are present: Chatsworth Formation Drainages, Chatsworth Formation Non-Drainages, Santa Susana Formation Drainages, and Santa Susana Formation Non-Drainages. • *Shallow and deep chemical concentrations:* Background soil chemistry in non-drainage conditions may vary between shallow or deep soils due to either geologic substrate materials or anthropomorphic air dispersion deposition (i.e., shallow and deep chemistry may be different for different chemicals). In drainages and drainage banks, shallow soil conditions are considered representative of this dynamic system through time. At SSFL, in areas where facilities have been constructed, there has been mixing of soil depths as evidenced in numerous historical photographs. • *Geographic evaluation tools*: GIS (digital elevation model, topographic map, and geologic map) and field reconnaissance to evaluate potential off-site sampling locations representative of SSFL site conditions. • *Naturally-occurring and anthropomorphic ambient chemicals*: These chemicals could occur naturally or be present due to man-made activities in undeveloped off-site background reference areas. The target analytes include metals, hexavalent chromium, fluoride, polychlorinated dioxin/furans, chlorinated pesticides/herbicides, polycyclic aromatic hydrocarbons (PAHs), perchlorate, phthalates, cyanide, formaldehyde, nitrate, and alcohols. Of these, organic chemicals are predominantly present only in surface soils and inorganic constituents are present in both surface and subsurface soils. Grain size analysis is included as a comparison parameter. • *Current SSFL environmental program requirements*: The chemical soil background data may be compared between the strata (defined above) and previously-collected on-site characterization data. Therefore, the chemical soil background data should be collected consistent with current field methods.

TABLE 1
DATA QUALITY OBJECTIVES
CHEMICAL SOIL BACKGROUND SAMPLING AND ANALYSIS PLAN
SANTA SUSANA FIELD LABORATORY (Page 2 of 4)

4. Study Boundaries

- *Population Characteristics*: New soil/sediment data to be collected in a stratified manner and in sufficient quantities to achieve a 95/95 UTL (per stratum):

Sample Population (Strata)	Analysis	Formation	Topography	Depth	Number of Samples
Chatsworth Non-Drainage	Inorganic	Chatsworth	Non-Drainage	Surface & Subsurface	60 (30 Surface; 30 Subsurface)
Chatsworth Drainage	Inorganic	Chatsworth	Drainage	Surface	60 Surface
Santa Susana Non-Drainage	Inorganic	Santa Susana	Non-Drainage	Surface & Subsurface	60 (30 Surface; 30 Subsurface)
Santa Susana Drainage	Inorganic	Santa Susana	Drainage	Surface	60 Surface
Combined Non-Drainage	Organic	Chatsworth & Santa Susana	Non-Drainage	Surface	60 (30 Chatsworth; 30 Santa Susana)
Combined Drainage	Organic	Chatsworth & Santa Susana	Drainage	Surface	60 (30 Chatsworth; 30 Santa Susana)
Note: In addition to the analytes presented in the SAP, cyanide, formaldehyde, and nitrate will be included during the laboratory analysis of the surface and subsurface soil samples collected from both drainages and non-drainage areas; also, alcohols will be included during the analysis of the subsurface samples collected from the non-drainage areas.					

- *Analytical Requirements*: Defined in Quality Assurance Project Plan (QAPP)
- *Field Sampling Requirements*: Defined in Sampling and Analysis Plan (SAP)
- *Spatial Boundary*: Sampling locations at least 3 miles beyond the SSFL boundary. Drainage bank widths defined as maximum 15 feet on either side of the channel centerline; to be defined in the field using professional judgment.
- *Spatial Boundary*: The chemical background reference areas (CBRAs) will be bounded and mapped using property lines, accessibility, and knowledge of the background study area use(s).
- *Collocated surface and subsurface sampling locations:* Surface samples analyzed for organic and inorganic chemicals, subsurface samples analyzed only for inorganic constituents.
- *Temporal Boundary*: Sample staking in March-April 2011, sample collection in June-July 2011.
- *Scale of Decision*: Natural off-site areas representative of SSFL site conditions (geology, landform types, wildfire histories) and undisturbed by localized human activities (i.e., roads, debris areas, etc.).
- *Practical Constraints*: Potential impediments to sample collection (i.e., site access, health and safety issues).

TABLE 1
DATA QUALITY OBJECTIVES
CHEMICAL SOIL BACKGROUND SAMPLING AND ANALYSIS PLAN
SANTA SUSANA FIELD LABORATORY (Page 3 of 4)

5. Decision Rules	• If a potential CBRA is representative of SSFL site conditions (geology, landform types, recent wildfire history) and has not been disturbed by obvious human activities (i.e., roads, etc.), then it should be considered as a CBRA. • If a CBRA is identified, then identify randomly-selected sampling locations based on the four physical characteristic groups / strata present at SSFL: Chatsworth Formation Drainages, Chatsworth Formation Non-Drainages, Santa Susana Formation Drainages, and Santa-Susana Formation Non-Drainages. • If an analytical laboratory can meet the study's reporting limit goals and has pre-selection acceptable audit findings, then it should be considered as a candidate laboratory for use in the chemical soil background study.
6. Limits on Decision Errors	• Potential disturbed areas from localized human activities in CBRAs will be identified using historical records (i.e., aerial photographs, maps, etc.), then visually during site reconnaissance and sampling visit(s). • For the non-parametric sample size calculation (to achieve a 95/95 UTL), a confidence level of 95% ($\alpha = 0.05$) and the content of the tolerance limit (proportion of future sampled population) (p) of 0.95, which yields 59 samples (per stratum). • The minimum statistical parameter for background stratum data may be based on a 95/95 UTL, assuming that 59 samples per stratum are collected. • Sampling design and laboratory measurement and analysis variability will be monitored by collecting a sufficient amount of quality control/quality assurance samples (i.e., splits, equipment rinsate blanks, duplicates, and matrix spike/matrix spike duplicates). • While the goal is 60 samples per stratum, unforeseen issues may occur that limit the number of samples that can be collected. If encountered, any limitations will be documented and described in the Chemical Soil Background Report.

7. Optimized Design	• Sampling and Analysis Plan
	  o Field Sampling Plan – describes the data quality objectives, sampling design of 60 samples per stratum, and field and laboratory methods for the study.
	  o Quality Assurance Project Plan – describes analytical reporting limits, quality assurance and quality control, and data validation requirements for the study.
	  o Field Sampling Standard Operating Procedures – describes field sampling methods consistent with on-site soil sampling procedures.
	  o Health and Safety Plan – describes health and safety procedures to be used during fieldwork - staking and sampling - (prepared by contractor doing the fieldwork).
	• Use a systematic design to bound potential sampling locations (e.g., grid overlay, drainage transects) and then select the sampling locations within those boundaries (or along transect) at random. If a sample location is infeasible (e.g., rock outcrop), a new location will be selected randomly[2, 3].
	• Provide planning documents to public for review and comment, address comments, and modify plan, if warranted.

TABLE 1
DATA QUALITY OBJECTIVES
CHEMICAL SOIL BACKGROUND SAMPLING AND ANALYSIS PLAN
SANTA SUSANA FIELD LABORATORY (Page 4 of 4)

Notes:

[1] The term 'strata' is used in this context as a statistical evaluation group, not as a geologic reference.

[2] Judgmental sampling does not allow the level of confidence (uncertainty) of the investigation to be accurately quantified. In addition, judgmental sampling limits the statistical inferences that may be made to the units actually analyzed and extrapolation from those units to the overall population from which the units were collected is subject to unknown selection bias (U.S. Environmental Protection Agency, 2002, Guidance for Choosing a Sampling Design for Environmental Data Collection, EPA/240/R-02/005, p. 28).

[3] Additional information of the field sampling design is provided as Appendix A of the SAP

Krishnamoorthy, K., and T. Mathew. 2009. Statistical Tolerance Regions: Theory, Applications, and Computation. Hoboken, NJ: Wiley.

TABLE 2
QUALITY CONTROL LIMITS (Page 1 of 9)

SOIL QUALITY CONTROL LIMITS						
Analyte	**MS/MSD**			**LCS/LCSD**		
	LCL (%)	**UCL (%)**	**RPD**	**LCL (%)**	**UCL (%)**	**RPD**
Phthalates, PAHs by EPA 8270C/8270C (SIM)						
Acenaphthene	31	137	19	lab LCL	lab UCL	lab RPD
Acenaphthylene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Anthracene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Benzo(a)anthracene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Benzo(a)pyrene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Benzo(b)fluoranthene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Benzo(g,h,i)perylene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Benzo(k)fluoranthene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
bis(2-Ethylhexyl) phthalate	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Butyl benzyl phthalate	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Chrysene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Dibenz(a,h)anthracene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Diethyl phthalate	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Dimethyl phthalate	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Di-n-butyl phthalate	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Di-n-octyl phthalate	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Fluoranthene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Fluorene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Indeno(1,2,3-cd)pyrene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Naphthalene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Phenanthrene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Pyrene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
1-Methylnaphthalene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
2-Methylnaphthalene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Dioxin/Furans By EPA 1613B						
2,3,7,8-TCDD	lab LCL	lab UCL	lab RPD	67	158	20
1,2,3,7,8-PeCDD	lab LCL	lab UCL	lab RPD	70	142	20
1,2,3,4,7,8-HxCDD	lab LCL	lab UCL	lab RPD	70	164	20
1,2,3,6,7,8-HxCDD	lab LCL	lab UCL	lab RPD	76	134	20
1,2,3,7,8,9-HxCDD	lab LCL	lab UCL	lab RPD	64	162	20
1,2,3,4,6,7,8-HpCDD	lab LCL	lab UCL	lab RPD	70	140	20
OCDD	lab LCL	lab UCL	lab RPD	78	144	20
2,3,7,8-TCDF	lab LCL	lab UCL	lab RPD	75	158	20
1,2,3,7,8-PeCDF	lab LCL	lab UCL	lab RPD	80	134	20
2,3,4,7,8-PeCDF	lab LCL	lab UCL	lab RPD	68	160	20
1,2,3,4,7,8-HxCDF	lab LCL	lab UCL	lab RPD	72	134	20
1,2,3,6,7,8-HxCDF	lab LCL	lab UCL	lab RPD	84	130	20
2,3,4,6,7,8-HxCDF	lab LCL	lab UCL	lab RPD	70	156	20
1,2,3,7,8,9-HxCDF	lab LCL	lab UCL	lab RPD	78	130	20
1,2,3,4,6,7,8-HpCDF	lab LCL	lab UCL	lab RPD	82	132	20

TABLE 2
QUALITY CONTROL LIMITS (Page 2 of 9)

SOIL QUALITY CONTROL LIMITS						
Analyte	**MS/MSD**			**LCS/LCSD**		
	LCL (%)	**UCL (%)**	**RPD**	**LCL (%)**	**UCL (%)**	**RPD**
1,2,3,4,7,8,9-HpCDF	lab LCL	lab UCL	lab RPD	78	138	20
OCDF	lab LCL	lab UCL	lab RPD	63	170	20
Metals by EPA 6010B/6020A						
Aluminum	75	125	20	70	130	20
Antimony	75	125	20	50	150	20
Arsenic	75	125	20	70	130	20
Barium	75	125	20	70	130	20
Beryllium	75	125	20	70	130	20
Boron	75	125	20	70	130	20
Cadmium	75	125	20	70	130	20
Calcium	75	125	20	70	130	20
Chromium	75	125	20	70	130	20
Cobalt	75	125	20	70	130	20
Copper	75	125	20	70	130	20
Iron	75	125	20	70	130	20
Lead	75	125	20	70	130	20
Lithium	75	125	20	70	130	20
Magnesium	75	125	20	70	130	20
Manganese	75	125	20	70	130	20
Molybdenum	75	125	20	70	130	20
Nickel	75	125	20	70	130	20
Phosphorus	75	125	20	70	130	20
Potassium	75	125	20	70	130	20
Selenium	75	125	20	70	130	20
Silver	75	125	20	50	150	20
Sodium	75	125	20	70	130	20
Strontium	75	125	20	70	130	20
Thallium	75	125	20	70	130	20
Tin	75	125	20	70	130	20
Titanium	75	125	20	70	130	20
Vanadium	75	125	20	70	130	20
Zinc	75	125	20	70	130	20
Zirconium	75	125	20	70	130	20
Mercury by EPA 7471A						
Mercury	75	125	20	lab LCL	lab UCL	lab RPD
Hexavalent Chromium by EPA 7199/7196A						
Hexavalent Chromium	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD

TABLE 2
QUALITY CONTROL LIMITS (Page 3 of 9)

SOIL QUALITY CONTROL LIMITS						
Analyte	**MS/MSD**			**LCS/LCSD**		
	LCL (%)	**UCL (%)**	**RPD**	**LCL (%)**	**UCL (%)**	**RPD**
Organochlorine Pesticides by EPA 8081A						
Aldrin	34	132	43	lab LCL	lab UCL	lab RPD
Alpha-BHC	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Beta-BHC	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Delta-BHC	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Gamma-BHC	46	127	50	50	120	lab RPD
Chlordane (Technical)	N/A	N/A	N/A	30	130	lab RPD
4,4'-DDD	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
4,4'-DDE	lab LCL	lab UCL	lab RPD	50	150	lab RPD
4,4'-DDT	23	134	50	lab LCL	lab UCL	lab RPD
Dieldrin	31	134	38	30	130	lab RPD
Endosulfan I	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Endosulfan II	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Endosulfan sulfate	lab LCL	lab UCL	lab RPD	50	120	lab RPD
Endrin	42	139	45	50	120	lab RPD
Endrin aledhyde	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Endrin ketone	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Heptachlor	35	130	31	lab LCL	lab UCL	lab RPD
Heptachlor epoxide	lab LCL	lab UCL	lab RPD	50	150	lab RPD
Methoxychlor	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Mirex	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Toxaphene	N/A	N/A	N/A	lab LCL	lab UCL	lab RPD
Chlorinated Herbicides by EPA 8151A						
2,4-D	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
2,4-DB	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
2,4,5-T	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
2,4,5-TP (Silvex)	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Dalapon	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Dicamba	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Dichloroprop	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Dinoseb	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
MCPA	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
MCPP	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Anions by EPA 300.0/9056A						
Fluoride	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Nitrate	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Perchlorate by EPA 6850/6860						
Perchlorate	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD

TABLE 2
QUALITY CONTROL LIMITS (Page 4 of 9)

SOIL QUALITY CONTROL LIMITS						
Analyte	**MS/MSD**			**LCS/LCSD**		
	LCL (%)	**UCL (%)**	**RPD**	**LCL (%)**	**UCL (%)**	**RPD**
Cyanide by EPA 9012A						
Cyanide	75	125	25	lab LCL	lab UCL	lab RPD
Formaldehyde by EPA 8315A						
Formaldehyde	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Alcohols by EPA 8015B						
Methanol	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Ethanol	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD

TABLE 2
QUALITY CONTROL LIMITS (Page 5 of 9)

WATER QUALITY CONTROL LIMITS						
Analyte	**MS/MSD**			**LCS/LCSD**		
	LCL (%)	**UCL (%)**	**RPD**	**LCL (%)**	**UCL (%)**	**RPD**
Phthalates, PAHs by EPA 8270C/8270C (SIM)						
2-Methylnaphthalene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Acenaphthene	46	118	31	lab LCL	lab UCL	lab RPD
Acenaphthylene	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Anthracene	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Benzo(a)anthracene	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Benzo(a)pyrene	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Benzo(b)fluoranthene	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Benzo(g,h,i)perylene	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Benzo(k)fluoranthene	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
bis(2-Ethylhexyl) phthalate	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Butyl benzyl phthalate	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Chrysene	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Dibenz(a,h)anthracene	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Diethyl phthalate	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Dimethyl phthalate	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Di-n-butyl phthalate	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Di-n-octyl phthalate	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Fluoranthene	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Fluorene	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Indeno(1,2,3-cd)pyrene	lab LCL	Lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Naphthalene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Phenanthrene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Pyrene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
1-Methylnaphthalene	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Dioxin/Furans By EPA 1613B						
2,3,7,8-TCDD	lab LCL	lab UCL	lab RPD	67	158	20
1,2,3,7,8-PeCDD	lab LCL	lab UCL	lab RPD	70	142	20
1,2,3,4,7,8-HxCDD	lab LCL	lab UCL	lab RPD	70	164	20
1,2,3,6,7,8-HxCDD	lab LCL	lab UCL	lab RPD	76	134	20
1,2,3,7,8,9-HxCDD	lab LCL	lab UCL	lab RPD	64	162	20
1,2,3,4,6,7,8-HpCDD	lab LCL	lab UCL	lab RPD	70	140	20
OCDD	lab LCL	lab UCL	lab RPD	78	144	20
2,3,7,8-TCDF	lab LCL	lab UCL	lab RPD	75	158	20
1,2,3,7,8-PeCDF	lab LCL	lab UCL	lab RPD	80	134	20
2,3,4,7,8-PeCDF	lab LCL	lab UCL	lab RPD	68	160	20
1,2,3,4,7,8-HxCDF	lab LCL	lab UCL	lab RPD	72	134	20
1,2,3,6,7,8-HxCDF	lab LCL	lab UCL	lab RPD	84	130	20
2,3,4,6,7,8-HxCDF	lab LCL	lab UCL	lab RPD	70	156	20
1,2,3,7,8,9-HxCDF	lab LCL	lab UCL	lab RPD	78	130	20

TABLE 2
QUALITY CONTROL LIMITS (Page 6 of 9)

WATER QUALITY CONTROL LIMITS						
Analyte	**MS/MSD**			**LCS/LCSD**		
	LCL (%)	**UCL (%)**	**RPD**	**LCL (%)**	**UCL (%)**	**RPD**
1,2,3,4,6,7,8-HpCDF	lab LCL	lab UCL	lab RPD	82	132	20
1,2,3,4,7,8,9-HpCDF	lab LCL	lab UCL	lab RPD	78	138	20
OCDF	lab LCL	lab UCL	lab RPD	63	170	20
Metals by EPA 6010B/6020A						
Aluminum	75	125	20	70	130	20
Antimony	75	125	20	50	150	20
Arsenic	75	125	20	70	130	20
Barium	75	125	20	70	130	20
Beryllium	75	125	20	70	130	20
Boron	75	125	20	70	130	20
Cadmium	75	125	20	70	130	20
Calcium	75	125	20	70	130	20
Chromium	75	125	20	70	130	20
Cobalt	75	125	20	70	130	20
Copper	75	125	20	70	130	20
Iron	75	125	20	70	130	20
Lead	75	125	20	70	130	20
Lithium	75	125	20	70	130	20
Magnesium	75	125	20	70	130	20
Manganese	75	125	20	70	130	20
Molybdenum	75	125	20	70	130	20
Nickel	75	125	20	70	130	20
Phosphorus	75	125	20	70	130	20
Potassium	75	125	20	70	130	20
Selenium	75	125	20	70	130	20
Silver	75	125	20	50	150	20
Sodium	75	125	20	70	130	20
Strontium	75	125	20	70	130	20
Thallium	75	125	20	70	130	20
Tin	75	125	20	70	130	20
Titanium	75	125	20	70	130	20
Vanadium	75	125	20	70	130	20
Zinc	75	125	20	70	130	20
Zirconium	75	125	20	70	130	20
Mercury by EPA 7470A						
Mercury	75	125	20	lab LCL	lab UCL	lab RPD
Hexavalent Chromium by EPA 7199/7196A						
Hexavalent Chromium	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD

TABLE 2
QUALITY CONTROL LIMITS (Page 7 of 9)

WATER QUALITY CONTROL LIMITS						
Analyte	**MS/MSD**			**LCS/LCSD**		
	LCL (%)	**UCL (%)**	**RPD**	**LCL (%)**	**UCL (%)**	**RPD**
Organochlorine Pesticides by EPA 8081A						
Aldrin	40	120	22	lab LCL	lab UCL	lab RPD
Alpha-BHC	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Beta-BHC	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Delta-BHC	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Gamma-BHC	56	123	15	50	120	lab RPD
Chlordane (Technical)	N/A	N/A	N/A	30	130	lab RPD
4,4'-DDD	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
4,4'-DDE	lab LCL	lab UCL	lab RPD	50	150	lab RPD
4,4'-DDT	38	127	27	lab LCL	lab UCL	lab RPD
Dieldrin	52	126	18	30	130	lab RPD
Endosulfan I	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Endosulfan II	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Endosulfan sulfate	lab LCL	lab UCL	lab RPD	50	120	lab RPD
Endrin	56	121	21	50	120	lab RPD
Endrin aledhyde	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Endrin ketone	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Heptachlor	40	131	20	lab LCL	lab UCL	lab RPD
Heptachlor epoxide	lab LCL	lab UCL	lab RPD	50	150	lab RPD
Methoxychlor	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Mirex	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Toxaphene	N/A	N/A	N/A	lab LCL	lab UCL	lab RPD
Chlorinated Herbicides by EPA 8151A						
2,4-D	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
2,4-DB	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
2,4,5-T	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
2,4,5-TP (Silvex)	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Dalapon	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Dicamba	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Dichloroprop	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Dinoseb	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
MCPA	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
MCPP	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Anions by EPA 300.0/9056A						
Fluoride	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Nitrate	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Perchlorate by EPA 6850/6860						
Perchlorate	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD

TABLE 2
QUALITY CONTROL LIMITS (Page 8 of 9)

WATER QUALITY CONTROL LIMITS						
Analyte	**MS/MSD**			**LCS/LCSD**		
	LCL (%)	**UCL (%)**	**RPD**	**LCL (%)**	**UCL (%)**	**RPD**
Cyanide by EPA 9012A						
Cyanide	75	125	25	lab LCL	lab UCL	lab RPD
Formaldehyde by EPA 8315A						
Formaldehyde	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Alcohols by EPA 8015B						
Methanol	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD
Ethanol	lab LCL	lab UCL	lab RPD	lab LCL	lab UCL	lab RPD

Notes:

N/A = Not applicable (parameter not included in MS/MSD)

- All numerical values are from the following USEPA Contract Laboratory Program (CLP) National Functional Guidelines:

  USEPA CLP National Functional Guidelines for Inorganic Superfund Data Review. OSWER 9240.1-51. EPA 540-R-10-011. January 2010.

  USEPA CLP National Functional Guidelines for Organic Methods Data Review. OSWER 9240.1-48. USEPA 540-R-08-01. June 2008.

  USEPA CLP National Functional Guidelines for dioxins/furans Data Review. OSWER 9240.1-51, USEPA 540-R-05-001. September 2005.

- Lab LCL, UCL, RPD = Laboratory statistically determined control criteria in accordance with NELAC standards.
- USEPA CLP National Functional Guidelines and reference methods must be used for all other applicable quality control criteria.

TABLE 2
QUALITY CONTROL LIMITS (Page 9 of 9)

Acronyms:

BHC - Benzene Hexachloride
D - Dichlorophenoxyacetic acid
DB - Dichlorophenoxy butyric acid
DCB - Dichlorobenzene
DDD - Dichlorodiphenyl dichloroethane
DDE - Dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethane
EPA - Environmental Protection Agency
HpCDD - Heptachlorodibenzo-p-dioxin
HpCDF - Heptachlorodibenzofuran
HxCDD - Hexachlorodibenzo-p-dioxin
HxCDF - Hexachlorodibenzofuran
LCL - Lower Control Limit
LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample Duplicate
MCPA - 2-methyl-4-chlorophenoxyacetic Acid
MCPP - 2-(4-chloro-2-methylphenoxy)propionic Acid
MS - Matrix Spike
MSD - Matrix Spike Duplicate
OCDD - Octachlorodibenzo-p-dioxin
OCDF - Octachlorodibenzofuran
QA/QC - Quality Assurance/Quality Control
PeCDD - Pentachlorodibenzo-p-dioxins
PeCDF - Pentachlorodibenzofuran
RPD - Replicate Percent Difference
SIM - Selected Ion Monitoring
T - Trichlorophenoxyacetic acid
TCDD - Tetrachlorodibenzo-p-dioxins
TCDF - Tetrachlorodibenzofuran
TP - Trichlorophenoxy propionic acid
UCL - Upper Control Limit

TABLE 3
SAMPLE CONTAINER, PRESERVATION, AND HOLDING TIMES (Page 1 of 3)

Matrix	Analyte	Method	Container	Minimum Amount	Preservative	Holding Time
Soil	Fluoride	EPA 300.0/9056A	Brass, acetate or SS tubes, glass	7 g	Cool to 4°C	28 days
	Nitrate	EPA 300.0	Brass or SS tubes; glass	7 g	Cool to 4°C	48 hours
	Cyanide	EPA 9012A	Brass or SS tubes; glass	3 g	Cool to 4°C	14 days
	Formaldehyde	EPA 8315A	Brass or SS tubes; amber glass	25g	Cool to 4°C	14 days for extraction and 3 days for analysis
	Dioxins/Furans	EPA 1613B	Brass or SS tubes; amber glass	32 g	Cool to 4°C	If properly stored, samples and extracts may be stored for up to 1 year
	Grain Size	ASTM D421/D422	Brass, Acetate or SS tubes, Glass	16 oz	NA	N/A
	Chlorinated Herbicides	SW-846 8151A	Brass or SS tubes; amber glass	75 g	Cool to 4°C	14 days for extraction and 40 days for analysis
	Hexavalent Chromium	7196A, 7199	Glass	94 g	Cool to 4°C	28 days
	Metals	SW-846 6010B/3050B, 6020A/3050B,7471A	SS tubes, Poly, glass	4 g	Cool to 4°C	6 months; 28 days for mercury
	Phthalates, PAHs	SW-8468270C/ 8270C(SIM)	Brass or SS tubes; amber glass	38 g	Cool to 4°C	14 days for extraction and 40 days for analysis

TABLE 3
SAMPLE CONTAINER, PRESERVATION, AND HOLDING TIMES (Page 2 of 3)

Matrix	Analyte	Method	Container	Minimum Amount	Preservative	Holding Time
	Organochlorine Pesticides	SW-846 8081A	Brass or SS tubes; amber glass	75 g	Cool to 4°C	14 days for extraction and 40 days for analysis
	Methanol/ Ethanol	SW-846 8015B	Encore Samplers	3/Sample	Cool to 4°C	48 Hours (7 days if frozen)
	Perchlorate	EPA 6850/6860,	Brass, Acetate or SS tubes, Glass	2 g	Cool to 4°C	28 days
	Moisture Content	EPA 160.3	Brass, acetate or SS tubes, glass	2g	Cool to 4°C	ASAP
Water	Fluoride	EPA 300.0	Poly	10ml	Cool to 4°C	28 days
	Nitrate	EPA 300.0	Glass	10ml	Cool to 4°C	48 Hours
	Cyanide	EPA 9012A	Poly	50 ml	Cool to 4°C NaOH and ascorbic acid	14 days
	Formaldehyde	EPA 8315A	Glass	100 ml	Cool to 4°C	3 days to extraction, 3 days to analysis
	Dioxins/Furans	EPA 1613B	Amber glass	1 Liter	Cool to 4°C	If properly stored, samples and extracts may be stored for up to 1 year
	Chlorinated Herbicides	SW-846 8151A	Amber glass	1 Liter	Cool to 4°C	7 days for extraction and 40 days for analysis

TABLE 3
SAMPLE CONTAINER, PRESERVATION, AND HOLDING TIMES (Page 3 of 3)

Matrix	Analyte	Method	Container	Minimum Amount	Preservative	Holding Time
	Hexavalent Chromium	7196A, 7199	Poly, glass	50 ml	Cool to 4°C	24 hours
	Metals	SW-846 6010B/3010A 6020A/3010A, 7470A	Poly	150 ml	Cool to 4°C HNO3 to pH<2	6 months; 28 days for mercury
	Phthalates, PAHs	SW-8468270C/ 8270C (SIM)	Amber glass	1 Liter	Cool to 4°C	7 days for extraction and 40 days for analysis
	Organochlorine Pesticides	SW-846 8081A	Amber Glass	1 Liter	Cool to 4°C	7 days for extraction and 40 days for analysis
	Perchlorate	EPA 6850/6860	Sterile HDPE	80 ml	Cool to 4°C	28 days
	Methanol/ Ethanol	SW-846 8015B	VOA Vials	2/Sample	Zero headspace, Cool to 4°C/ HCL<2	14 days

Notes:

°C - degree Centigrade
EPA - Environmental Protection Agency
HNO3 - Nitric acid
g – Grams
ml – Milliliter

PAH - Polynuclear Aromatic Hydrocarbons
Poly - polyethylene
SS - stainless steel
SIM - Selective Ion Monitoring
HDPE - High-Density Polyethylene

TABLE 4
ANALYTICAL METHODS AND REPORTING LIMITS (Page 1 of 4)

Method / Analyte	Minimum Reporting Limit Soil	Minimum Reporting Limit Water
Anions by EPA Method 300.0 / 9056A	**ppm (mg/kg)**	**ppm(mg/L)**
Fluoride	1	0.50
Nitrate	1.5	0.50
Cyanide by EPA Method 9012A	**ppm (mg/kg)**	**ppm(mg/L)**
Cyanide	0.5	0.010
Formaldehyde by EPA 8315A	**ppb (µg/kg)**	**ppb (ug/L)**
Formaldehyde	3000	50
Alcohols by EPA 8015B	**ppb (µg/kg)**	**ppb (µg /L)**
Methanol	500	1000
Ethanol	500	1000
Chlorinated Herbicides by EPA Method 8151A	**ppb (µg/kg)**	**ppb (µg /L)**
2,4,5-T	0.17	0.050
2,4,5-Trichlorophenoxypropionic acid (2,4,5-TP)	0.17	0.050
2,4-Dichlorophenoxyacetic Acid (2,4-D)	3.6	0.50
2,4-Dichlorophenoxybutyric acid (2,4-DB)	1.7	1.0
Dalapon	9	1.3
Dicamba	1.2	0.30
Dichlorprop	1.7	0.50
Dinoseb	2.4	0.50
MCPA	250	1000
MCPP	250	200
Grain Size by ASTM Method D421/D422	mm	**N/A**
Particle Size		**N/A**
Hexavalent Chromium by EPA Methods 7199/7196A	**ppm (mg/kg)**	**ppb(µg/L)**
Hexavalent chromium	1	10
Mercury by EPA Methods 7471A/7470A	**ppm (mg/kg)**	**ppm (mg/L)**
Mercury	0.1	0.00020
Metals by EPA Methods 6010B/6020A	**ppm (mg/kg)**	**ppb (mg/L)**
Aluminum	20	0.200
Antimony	0.2	0.0010
Arsenic	0.4	0.0020
Barium	0.5	0.0020
Beryllium	0.1	0.00050
Boron	5	0.0500
Cadmium	0.1	0.00050
Calcium	20	0.200
Chromium	0.4	0.0020

TABLE 4
ANALYTICAL METHODS AND REPORTING LIMITS (Page 2 of 4)

Method / Analyte	Minimum Reporting Limit Soil	Minimum Reporting Limit Water
Cobalt	0.1	0.00050
Copper	0.4	0.0020
Iron	20	0.200
Lead	0.2	0.0010
Lithium	2	0.0200
Magnesium	10	0.100
Manganese	0.5	0.0050
Molybdenum	0.1	0.00050
Nickel	0.4	0.0020
Phosphorus	10	0.100
Potassium	50	0.500
Selenium	0.4	0.0020
Silver	0.1	0.00050
Sodium	100	1.00
Strontium	0.5	0.0050
Thallium	0.1	0.00050
Tin	10	0.0200
Titanium	1	0.0100
Vanadium	0.1	0.00050
Zinc	3	0.015
Zirconium	5	0.050
PAHs, Phthalates by EPA Method 8270C, 8270C (SIM)	**ppb (µg/kg)**	**ppb (µg/L)**
1-Methyl naphthalene	1.67	0.050
2-Methylnaphthalene	1.67	0.05
Acenaphthene	1.67	0.05
Acenaphthylene	1.67	0.05
Anthracene	1.67	0.05
Benzo(a)anthracene	1.67	0.05
Benzo(a)pyrene	1.67	0.05
Benzo(b)fluoranthene	1.67	0.05
Benzo(ghi)perylene	1.67	0.05
Benzo(k)fluoranthene	1.67	0.05
bis(2-Ethylhexyl) phthalate	100	1
Butyl benzyl phthalate	10	0.2
Chrysene	1.67	0.05
Dibenzo(a,h)anthracene	1.67	0.05
Diethyl phthalate	10	0.2
Dimethyl phthalate	10	0.2

TABLE 4
ANALYTICAL METHODS AND REPORTING LIMITS (Page 3 of 4)

Method / Analyte	Minimum Reporting Limit Soil	Minimum Reporting Limit Water
Di-n-butyl phthalate	20	0.2
Di-n-octyl phthalate	10	0.2
Fluoranthene	1.67	0.05
Fluorene	1.67	0.05
Indeno(1,2,3-cd)pyrene	1.67	0.05
Naphthalene	1.67	0.05
Phenanthrene	1.67	0.05
Pyrene	1.67	0.05
Organochlorine Pesticides by 8081A	**ppb (µg/kg)**	**ppb (µg/L)**
4,4'-DDD	0.34	0.02
4,4'-DDE	0.34	0.02
4,4'-DDT	0.34	0.02
Aldrin	0.166	0.01
alpha-BHC	0.166	0.01
beta-BHC	0.166	0.01
Chlordane (Technical)	3.4	0.5
delta-BHC	0.166	0.01
Dieldrin	0.34	0.02
Endosulfan I	0.166	0.01
Endosulfan II	0.34	0.02
Endosulfan sulfate	0.34	0.02
Endrin	0.34	0.02
Endrin aldehyde	0.34	0.1
Endrin ketone	0.34	0.02
gamma-BHC	0.166	0.01
Heptachlor	0.166	0.01
Heptachlor epoxide	0.166	0.01
Mirex	0.34	0.25
p,p'-Methoxychlor	1.66	0.1
Toxaphene	6.6	3
Dioxins/Furans by EPA Method 1613B	**ppt (pg/g)**	**ppt (ng/L)**
1,2,3,4,6,7,8-HpCDF	0.20	0.025
1,2,3,4,6,7,8-HpCDD	0.20	0.025
1,2,3,4,7,8,9-HpCDF	0.20	0.025
1,2,3,4,7,8-HxCDF	0.20	0.025
1,2,3,4,7,8-HxCDD	0.20	0.025
1,2,3,6,7,8-HxCDF	0.20	0.025
1,2,3,6,7,8-HxCDD	0.20	0.025
1,2,3,7,8,9-HxCDF	0.20	0.025

TABLE 4
ANALYTICAL METHODS AND REPORTING LIMITS (Page 4 of 4)

Method / Analyte	Minimum Reporting Limit Soil	Minimum Reporting Limit Water
1,2,3,7,8,9-HxCDD	0.20	0.025
1,2,3,7,8-PeCDF	0.20	0.025
1,2,3,7,8-PeCDD	0.20	0.025
2,3,4,6,7,8-HxCDF	0.20	0.025
2,3,4,7,8-PeCDF	0.20	0.025
2,3,7,8-TCDD	0.040	0.005
2,3,7,8-TCDF	0.040	0.005
OCDF	0.40	0.05
OCDD	0.40	0.05
Perchlorate by EPA 6850/6860	**ppb (µg/kg)**	**ppb (ug/L)**
Perchlorate	5	1

Notes/Acronyms:
BHC - Benzene Hexachloride
DDD - Dichlorodiphenyl dichloroethane
DDE - Dichlorodiphenyldichloroethylene
DDT - Dichlorodiphenyltrichloroethane
EPA - Environmental Protection Agency
HpCDD - Heptachlorodibenzo-p-dioxin
HpCDF - Heptachlorodibenzofuran
HxCDD -Hexachlorodibenzo-p-dioxin
HxCDF - Hexachlorodibenzofuran
kg - kilogram
mg – milligram
ng/L – nanograms per liter
pg/g – picograms per gram
L - Liter
OCDD - Octachlorodibenzo-p-dioxin
OCDF -Octachlorodibenzofuran
PAH - Polynuclear Aromatic Hydrocarbons
PeCDD - Pentachlorodibenzo-p-dioxins
PeCDF - Pentachlorodibenzofuran
ppb - parts per billion
ppm - parts per million
ppt - parts per trillion
RL - Reporting Limit
SIM – Selected Ion Monitoring
TCDD - Tetrachlorodibenzo-p-dioxins
TCDF – Tetrachlorodibenzofuran
ug - microgram